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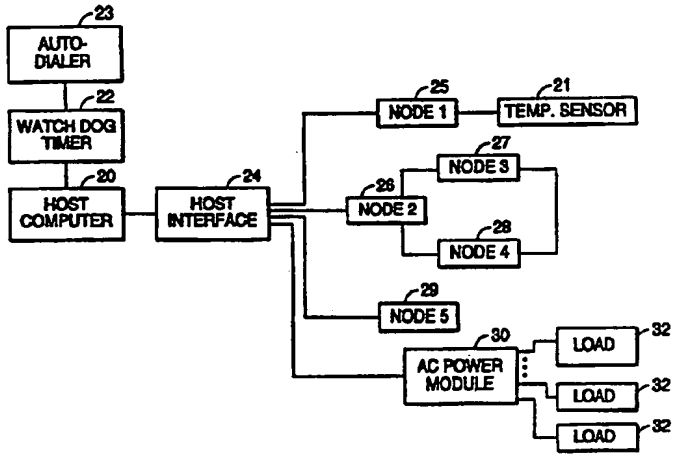

(57) Abstract

A home automation system comprises a number of sub-systems for controlling various aspects of a house, such as a security sub-system (50), and HVAC sub-system (70), a lighting control sub-system, and an entertainment sub-system. The network comprises a host computer (20) connected through a host interface (24) to a plurality of nodes (25-30). The network is in a free form topology and employ asynchronous communication. The host computer (20) polls each node on the network to determine system configuration and to perform a diagnostic check on the system. The messages that are transmitted between the nodes are comprised of a source address, a destination address that uniquely indentifies the location of each piece of hardware on the system, a message type field, and a data length segment. Each hardware device has a mirror image software object in the host computer to which messages are directed.

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HOME AUTOMATION SYSTEM

BACKGROUND OF THE INVENTION

Field of the Invention

This invention generally relates to a home automation system and, more particularly, to an interface between a host computer and a network, to a watchdog timer, to a method of polling nodes, to a software message scheme, to a common method of controlling sub-systems in the home automation system, and to a button keypad assembly.

Additionally, this invention relates to a temperature sensor for accurately measuring ambient temperature. More specifically, it relates to an apparatus for providing a temperature-indicating signal to a home automation system which maintains a desired temperature in a closed environment.

Description of the Prior Art

Fig. 1 illustrates a network configuration of a prior art home automation system. The network comprises a host computer 10 set up in a daisy-chain configuration with a plurality of nodes 12, 14, and 16. The network has synchronous communication between the host computer 10 and the nodes whereby each message transmitted from the host computer 10 passes through each node. With this system, each message passes through each node until the message reaches the node addressed by the transmitted message. This node receives and processes the message and then transmits the message to the next node. Each node has a transceiver for receiving the message from a previous node and for transmitting the message to the next node. The host computer 10 receives the circulated message from the last node in the loop and checks the message for errors.

The message is comprised of a command byte, a node byte, and one data byte. The command byte indicates

whether the message is just a command or if it also has a data byte along with the command. The node byte identifies the node to which the message is directed and the data byte contains the actual data. Therefore, for instance, to update the display of an LCD display at some node on the network, each character in the display had to be sent to the node with a different message. As another example, in order to dim the lights, messages were continuously transmitted to the node until the accepted level was reached.

Each byte is individually transmitted onto the daisy-chain network where it is circulated around the network to each node. The host computer 10 waits until a byte has been completely circulated around the loop and then checks the byte for errors. The node byte can address up to 80 different nodes and contains a node ID data segment and a connection data segment.

As should be apparent from the above description, the prior art home automation system uses a short data link resulting in relatively slow communication between the host computer 10 and the nodes. Also, a failure of a node in the loop disables the entire network by producing a discontinuity.

Additionally, in the prior art home automation system, with reference to Fig. 2, the host computer 10 received operating power from a central PC power supply 19, which also supplied power to the various nodes 12, 14, 16, and 17 in the network. With this system, when the supply of power to the host computer 10 is interrupted, the various nodes in the network would also be disconnected from power. Thus, a single power failure could disable the entire system, including the security system. In addition to the problems in reliability, the prior art power system could only accommodate a limited number of components. Thus, the prior art home automation system was limited in its ability to expand to accommodate more nodes.

Furthermore, previous prior art home automation systems are typically a collection of sub-systems produced by different manufacturers which are designed to work as stand alone systems in the home. These prior art home automation systems combine the third party sub-systems, such as lighting control sub-systems, audio/video control sub-systems, and security sub-systems, and provide limited communication to a central computer with automation software.

With such a prior art home automation system, a user needs to learn how to operate each one of the sub-systems. Additionally, if communication is necessary between the user and the sub-system, the user must learn how to use the interface to the central computer or must call a service representative to make any desired changes to the system. Thus, the user must learn a separate manner of operating and communicating with each sub-system in the home automation system, which is typically between four and six sub-systems.

For instance, a prior art home automation system may use an existing home security system with its own unique keypad and set of keystrokes and link it to a central controller. A prior art home automation system may also connect the central controller to an existing lighting system, with its own unique keypad and set of keystrokes to control the lighting. Other sub-systems, with their own unique methods and devices for communicating with a user, may also be connected to the central controller. For a user to control the security system, to control the lights, and to control the other sub-systems, the user must learn how to interface with the security sub-system, the lighting control sub-system, as well as the other sub-systems.

A problem exists with this system in that it becomes rather difficult and complicated for a user to properly control each system. Because each sub-system has its own unique device and method of interfacing with the user, it bec mes even more difficult and burdensome

for a user to operate the prior art home automation system.

As a result, users of home automation systems typically do not operate the home automation system to its full capacity. Instead, a technician will set up the home with several global scenarios over which the home owner will have limited control. If the user desires a change in the system or wishes to take advantage of the system's capability, a technician is typically called to do the interfacing with the system.

The prior art home automation systems may be used to automatically control a variety of activities such as turning lights and appliances on and off. Additionally, such systems may be used to regulate the ambient climate in a closed environment such as a home or office. Climate control may include the maintenance of a desired ambient temperature or humidity level.

The most common method of maintaining a desired ambient temperature in a closed environment is to provide a temperature sensor together with a thermostat. However, many conventional home automation systems utilize solid state components in such arrangements which are continuously active. This results in the generation of heat which introduces error into the temperature sensing circuit. While it may be attempted to shield the sensing component from the remainder of the circuit, the heat generated from active components is often not sufficiently eliminated. Alternatively, the sensing component may be separated from the remainder of the sensing circuit in order to reduce the error introduced by the other components. It may also be separated in order to place it in an optimum location in a particular environment, for example away from direct sunlight or from heating or cooling ducts. However, if the sensing component is separated from the remainder of the circuit by a relatively large distance, error is introduced in the reading from transmission noise and the like. This problem is

particularly pronounced where a voltage signal is used to indicate the ambient temperature.

Accordingly, there is a need to provide a temperature sensing circuit capable of obtaining stable, accurate measurement of the ambient temperature in various closed environments. There is a particular need to provide a sensing circuit which is capable of providing accurate temperature measurements to a temperature control device separated by a relatively long distance and which does generates a relatively small amount of heat.

The prior art home automation system has several diagnostic features incorporated in both the hardware and software in order to overcome problems associated with failure of certain parts of the system. The basic approach of these features is to detect and indicate a failure in an aspect of the system. However, there remains a risk that the host computer 10 itself will fail, thereby eliminating the means by which the operator is alerted to a problem with the system. Hence there is a need to monitor the system and provide an indication that the host computer 10 no longer is operating.

The prior art home automation systems also used button interfaces that were prone to several problems. One problem was that the interfaces were relatively complex requiring strict tolerances between parts. It was therefore prone to improperly fitting parts. Another problem was that covers for the interfaces were not securely fastened to a backplate so that the cover would fall off rather easily. Thus, it was a problem in the prior art to provide an economical and securely fastened interface.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an apparatus for interfacing a host computer to a link power network.

It is also an object of the present invention to provide a host interface that buffers and optically isolates signals supplied to a host computer from signals on a link power network.

It is another object of the present invention to provide a home automation system that can perform diagnostic measures to detect when a node has been disconnected from the network.

It is a further object of the present invention to provide a home automation system that can automatically add new nodes to the network.

It is yet another object of the present invention to provide a home automation system that has an addressing scheme which uniquely identifies each hardware device and each software object in the network.

It is yet a further object of the present invention to provide a home automation system where each hardware device has a mirror image software object.

It is still another object of the present invention to provide a single means of interfacing that is shared with more than one sub-system in the home automation system.

It is still a further object of the present invention to provide a temperature sensor that is accurate and stable and which generates a relatively small amount of heat.

It is also an object of the present invention to provide a watch dog timer that accurately detected failures in the home automation system.

It is another object of the present invention to provide a interface that is economical yet has a cover that securely fastens to a backplate.

Additional objects, advantages and novel features of the invention will be set forth in the description which follows, and will become apparent to those skilled in the art upon reading this description or practicing the invention. The objects and advantages of the

invention may be realized and attained by the appended claims.

To achieve the foregoing and other objects, in accordance with the present invention, as embodied and broadly described herein, a first aspect of the invention comprises an apparatus for interfacing a host computer to a link power network. The apparatus comprises a network interface circuit connected to the link power network for filtering out informational signals from a DC component. The network interface circuit supplies the informational signals to a neuron processor circuit, which then processes the signals and outputs a converted form of the informational signals. The converted informational signals are passed through a bus interface circuit before being supplied to the host computer. The bus interface circuit provides buffering and handshaking signals for the communication between the neuron processor circuit and the host computer.

A second aspect of the invention comprises a home automation system having a number of sub-systems, such as a security sub-system, a lighting control sub-system, and an environmental control sub-system. The home automation system comprises a controller for providing centralized control of the sub-systems and an interface for connecting the controller to a network. A plurality of nodes located in the various sub-systems are connected in a free form topology on the network and are in asynchronous communication with the controller. The controller transmits at periodic intervals a message to each node on the network. Each node then responds to this message by transmitting an acknowledgement message to the controller. The controller detects whether a node has been disconnected from the network based upon a comparison of the received acknowledgement messages to a directory containing a list of all nodes that should be on the network.

A third aspect of the invention comprises a h me automation system having a number of sub-systems,

such as a security sub-system, a lighting control sub-system, and an environmental control sub-system. The home automation system comprises a controller for providing centralized control of the sub-systems and an interface for connecting the controller to a network. The controller and the nodes use an addressing scheme that has an address for indicating the source of the message, an address for indicating the destination of the message, a segment indicating the type of message, a segment indicating the length of the message, as well as the data in the message. The destination address uniquely identifies each object that forms part of the network, whether that object is a hardware device physically on the network or a software object representing a hardware device. Preferably, all communication to and from each hardware device is through its mirror image software object.

A fourth aspect of the invention comprises a home automation system having a number of sub-systems, such as a security sub-system, a lighting control sub-system, and an environmental control sub-system. The home automation system comprises a controller for providing centralized control of the sub-systems and an interface for connecting the controller to a network. The home automation system also has a first user interface for a first sub-system and a second user interface for a second sub-system. A first user input at the first user interface controls a first hardware device in the same manner as a second hardware device is controlled when the first user input is detected at the second user interface. Also, a second user input at the first user interface controls the first hardware device in the same manner as the second hardware device is controlled when the second user input is detected at the second user interface. Thus, the user interfaces for the first and second user interfaces employ a common means of controlling associated devices.

A fifth aspect of the invention comprises a watch dog timer for use in a home automation system.

According to this embodiment of the invention, a watch dog timer circuit initiates a phone call to an off-site location when an operation signal is not received in a predetermined time interval from the host processor. In this way, an indication is provided to the off-site location that the host processor is not operational.

A sixth aspect of the invention comprises a temperature sensor for use in a home automation system. According to this embodiment of the invention, the environmental control sub-system includes a controller which periodically pulses a temperature sensor circuit to an operational mode whereby the temperature sensor circuit provides a signal indicating an ambient temperature of an environment in which the sensor is located.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in, and form a part of, the specification, illustrate embodiments of the present invention and, together with the description, serve to explain the principles of the invention. In the drawings:

Fig. 1 is a block diagram of a network configuration in a prior art home automation system;

Fig. 2 is a block diagram of a power supply system in a prior art home automation system;

Fig. 3 is a network configuration of a home automation system according to an embodiment of the invention;

Fig. 4 is a block diagram of a host interface;

Fig. 5 is a schematic diagram of an opto-isolation circuit in the host interface;

Fig. 6 is a schematic diagram of a neuron processor circuit in the host interface;

Fig. 7 is a schematic diagram of a bus interface circuit in the host interface;

Fig. 8 is a schematic diagram of a watch dog timer;

CLAIMS

1. An apparatus for interfacing a host computer to a link power network, comprising:

a network interface circuit, connected to said link power network, for receiving signals transmitted over said link power network and for filtering said signals to isolate informational signals from a DC component;

a neuron processor circuit for receiving said informational signals from said network interface circuit, for processing said informational signals, and for converting said informational signals into a different format; and

a bus interface circuit for providing said informational signals of said different format to said host computer, for buffering communication between said neuron processor circuit and said host computer, and for providing handshaking signals between said neuron processor circuit and said host computer;

whereby said host computer is interfaced to said link power network.

2. The apparatus for interfacing a host computer to a link power network as set forth in claim 1, wherein said bus interface circuit comprises buffer memories for buffering communication from said host computer to said neuron processor circuit and for buffering communication from said neuron processor circuit to said host computer.

3. The apparatus for interfacing a host computer to a link power network as set forth in claim 2, wherein said buffer memories comprise FIFO memories.

4. The apparatus for interfacing a host computer to a link power network as set forth in claim 1, wherein said bus interface circuit comprises a reset circuit for generating a reset signal upon power up and for also enabling said reset signal to be initiated through software.

5. The apparatus for interfacing a host computer to a link power network as set forth in claim 1, wherein said network interface circuit comprises buffer amplifiers and optical isolators for buffering and optically isolating said informational signals from said signals on said link power network.

6. The apparatus for interfacing a host computer to a link power network as set forth in claim 1, wherein said neuron processor circuit also receives signals directly from said host computer when said host computer places said neuron processor circuit in a slave mode of operation.

7. An automation system having a security subsystem, a lighting sub-system, and an environmental control sub-system, comprising:

a controller for providing centralized control of a plurality of sub-systems in said automation system;

a host interface for interfacing said central controller to a network;

a plurality of nodes connected to said network in a free form topology, said nodes being located in said sub-systems and being in asynchronous communication with said central controller;

wherein said central controller transmits at periodic intervals a diagnostic message to each node on the network and each of said nodes replies to said message by transmitting an acknowledgement message; and

wherein said central controller is connected to a directory of all nodes that should be on said network

and said central controller determines whether a node has been disconnected from said network based upon a comparison of all acknowledgement messages received from said nodes with said directory.

8. The automation system as set forth in claim 7, wherein said directory comprises an ISE directory having a list of all nodes connected to the network and also a list of all software objects connected to the network.

9. The automation system as set forth in claim 7, wherein said network comprises a link power network having said diagnostic message and the acknowledgement messages modulated on a DC voltage.

10. The home automation system as set forth in claim 7, wherein said environmental control sub-system is controlled by one of said plurality of nodes, said one of said nodes providing first signals to operate pulse a temperature sensor circuit to an operational mode wherein said temperature sensor circuit provides a signal indicating an ambient temperature of an environment in which the sensor is located.

11. The home automation system as set forth in claim 7, wherein said controller periodically supplies a signal to a watch dog timer circuit, said watch dog timer circuit including timer means which initiates a phone call to an off-site location when said operation signal is not received in a predetermined time interval thereby indicating to said off-site location that said processor is not operational.

12. An automation system having a security sub-system, a lighting sub-system, and an environmental control sub-system, comprising:

a controller for providing centralized control of a plurality of sub-systems in said automation system;

a host interface for interfacing said central controller to a network;

a plurality of nodes connected to said network and located in said sub-systems;

wherein said controller and said nodes communicate with each other by transmitting messages, each message comprising a destination address designating a node to receive the message and wherein only said node having said destination address intercepts said transmitted message off of said network.

13. The automation system as set forth in claim 12, wherein said message further comprises a source address indicating a source of the message, a message type segment indicating the type of the message, a data length segment indicating the length of the message, and data.

14. The automation system as set forth in claim 12, wherein said destination address comprises a domain segment, a node ID segment, a type segment, a subtype segment, a board segment, and a connection segment.

15. The automation system as set forth in claim 12, wherein each hardware device on said network has a mirror image software object residing in said controller.

16. The automation system as set forth in claim 15, wherein when said controller need to obtain information from a hardware device, said controller transmits a message to its mirror image software object which then transmits said message to its associated hardware device.

17. The automation system as set forth in claim 15, wherein data has been requested from a hardware device from another node, said hardware device transmits said data to its mirror image software object which then transmits said data to said another node.

18. The automation system as set forth in claim 15, wherein said destination address comprises a domain segment for distinguishing each hardware device from its mirror image software object.

19. The automation system as set forth in claim 12, wherein said destination address comprises a domain segment, a type segment, and a node ID segment that uniquely identify each node.

20. The automation system as set forth in claim 12, wherein said destination address comprises a type segment that distinguishes one type of node from other types of nodes.

21. The automation system as set forth in claim 12, wherein said destination address comprises a subtype segment that identifies the type of each hardware device connected to said plurality of nodes.

22. The automation system as set forth in claim 12, wherein said controller broadcasts a single message to every hardware device sharing the same subtype segment.

23. The automation system as set forth in claim 12, wherein said destination address comprises a board segment that identifies the location of each hardware device connected to said plurality of nodes.

24. The automation system as set forth in claim 12, wherein said destination address comprises a connection segment that identifies every connection on a hardware device, said hardware device being connected to one of said plurality of nodes.

25. The automation system as set forth in claim 12, wherein said controller transmits a plurality of diagnostic messages and each node on the network transmits an acknowledgement message back to the controller; and

wherein said controller determines whether a node has been disconnected from the network based upon a comparison of the acknowledgement messages received from the nodes to a directory containing a configuration of said network.

26. The home automation system as set forth in claim 12, wherein said environmental control sub-system is controlled by one of said plurality of nodes, said one of said nodes providing first signals to operate pulse a temperature sensor circuit to an operational mode wherein said temperature sensor circuit provides a signal indicating an ambient temperature of an environment in which the sensor is located.

27. The home automation system as set forth in claim 12, wherein said controller periodically supplies a signal to a watch dog timer circuit, said watch dog timer circuit including timer means which initiates a phone call to an off-site location when said operation signal is not received in a predetermined time interval thereby indicating to said off-site location that said processor is not operational.

28. An automation system having a plurality of sub-systems, such as a security sub-system, a lighting sub-system, and an environmental control sub-system, comprising:

a controller for providing centralized control of said plurality of sub-systems in said automation system;

a host interface for interfacing said central controller to a network;

a first user interface connected to said network for enabling a user to interface with a first sub-system in said automation system to control a first hardware device in a first and second manner respectively in response to a first user input and a second user input;

a second user interface connected to said network for enabling said user to interface with a second sub-system in said automation system to control a second hardware device in said first and second manner respectively in response to said first user input and said second user input;

wherein said first input from said user is used at said first user interface and said second user interface to respectively control both said first hardware device and said second hardware device in said first manner and said second input from said user is used at said first user interface and said second user interface to respectively control said first hardware device and said second hardware device in said second manner.

29. The automation system as set forth in claim 28, wherein said first user interface comprises:

first means for detecting input signals from said user at said first user interface;

first means for toggling activation of said first hardware device associated with said first sub-system with detection, by said first detecting means, of said first input from said user;

first means for increasing a value of a parameter associated with said first hardware device with detection, by said first detecting means, of said second input from said user; and

first means for decreasing a value of said parameter with detection, by said first detecting means, of a third input from said user; and

said second user interface comprises:

second means for detecting input signals from said user at said second user interface;

second means for toggling activation of said second hardware device associated with said second sub-system with detection, by said second detecting means, of said first input from said user;

second means for increasing a value of a parameter associated with said second hardware device with detection, by said second detecting means, of said second input from said user; and

second means for decreasing a value of said parameter with detection, by said second detecting means, of said third input from said user;

wherein said first hardware device and its associated parameter and said second hardware device and its associated parameter are similarly controlled by said first input, said second input, and said third input.

30. The automation system as set forth in claim 28, wherein said first sub-system comprises said lighting control sub-system, said first hardware device comprises a light, said parameter associated with said first hardware device comprises an intensity of said light; and

said second sub-system comprises said environmental control sub-system, said second hardware device comprises a heating unit, and said parameter associated with said second hardware device comprises a heat set point.

31. The automation system as set forth in claim 29, wherein said first input from said user comprises a toggle of a button, said second input from said user comprises a holding down of said button past a time out period, and said third input from said user comprises the holding down of said button past a time out period followed by a release of said button and then a second holding down of said button.

32. An automation system having a home security sub-system, a lighting sub-system, and an environmental control sub-system, comprising:

a controller for providing centralized control of a plurality of sub-systems in said home automation system;

a host interface for interfacing said central controller to a network; and

a plurality of nodes connected to said network and located in said sub-systems;

wherein said environmental control sub-system includes a heating, ventilation and air-conditioning (HVAC) controller which controls operation of a HVAC unit according to a comparison of a first signal corresponding to a desired temperature and a second signal corresponding to an actual temperature value, said actual temperature value being obtained from a temperature sensor circuit.

33. The automation system as set forth in claim 32, wherein said temperature sensor circuit comprises a fixed current source in parallel with a temperature-dependent variable circuit, said temperature sensor circuit outputting a temperature dependent current to converter means for obtaining said second signal from said temperature dependent current.

34. The automation system according to claim 33 wherein said temperature-dependent variable circuit comprises:

a temperature dependent sensor, said temperature dependent sensor outputting a voltage which varies linearly with changes in ambient temperature; and

means for converting said voltage to a current.

35. The automation system according to claim 34, wherein said means for converting said voltage to a current includes an operational amplifier having an output coupled to a base terminal of a transistor, said transistor having an emitter terminal coupled to a resistive element and an input to said operational amplifier.

36. The automation system according to claim 35, wherein said fixed current source includes a voltage sensor which supplies a fixed voltage to a first input of a second operational amplifier, said second operational amplifier having an output coupled to a base terminal of a second transistor, said second transistor having an emitter terminal coupled to a second resistive element and an input to a second input of said second operational amplifier.

37. The automation system according to claim 32 wherein said temperature sensor circuit remains non-operational until an operate signal is output from said HVAC controller, said operate signal pulsing said temperature sensor circuit to an operational state in which said actual temperature value is obtained.

38. A temperature sensor circuit for providing a current signal indicating an ambient temperature to a controller, comprising:

a temperature variable current source including a temperature dependent sensor which provides a voltage that varies linearly with changes in ambient temperature

to a first input to a first operational amplifier, said first operational amplifier having an output coupled to a base terminal of a first transistor, said first transistor having an emitter terminal coupled to a first resistive element and an input to said operational amplifier; and

a fixed current source in parallel with said variable current source, said fixed current source including a voltage sensor which supplies a fixed voltage to a first input of a second operational amplifier, said second operational amplifier having an output coupled to a base terminal of a second transistor, said second transistor having an emitter terminal coupled to a second resistive element and an input to a second input of said second operational amplifier;

wherein said temperature sensor circuit remains non-operational until an operate signal is output from said controller, said operate signal pulsing said first and second operational amplifiers, said fixed voltage sensor and said temperature dependent voltage sensor to an operational state in which said actual temperature value is obtained.

39. An automation system having a home security sub-system, a lighting sub-system, and an environmental control sub-system, comprising:

a controller for providing centralized control of a plurality of sub-systems in said home automation system;

a host interface for interfacing said central controller to a network;

a plurality of nodes connected to said network and located in said sub-systems; and

a watch dog timer circuit;

wherein said controller periodically supplies a signal to a watch dog timer circuit, said watch dog timer circuit including timer means which initiates a phone call to an off-site location when said operation signal

is not received in a predetermined time interval thereby indicating to said off-site location that said processor is not operational.

40. A button interface for use in a home automation system, comprising:

a back plate having a bottom portion and four side walls, wherein said back plate has two L-shaped brackets for mounting in a standard electrical box, three of said four side walls are perpendicular to said bottom portion, a fourth side wall is at an angle slightly more than 90°, and a first side wall, located opposite said fourth side wall, has two holes; and

a cover plate having a top portion and four side walls, wherein three of said four side walls are perpendicular to said top portion, a fourth side wall is at an angle slightly less than 90°, and a first side wall, located opposite said fourth side wall, has two protrusions;

wherein when assembling said back plate with said cover plate, said fourth wall of said back plate engages said fourth wall of said cover plate and said protrusions on said first wall of said cover plate mate with said holes in said first wall of said back plate whereby said cover plate is securely fastened to said back plate.

41. The button interface as set forth in claim 40, wherein said cover plate further comprises means for mounting printed circuit boards and for mounting at least one button.

42. The button interface as set forth in claim 40, wherein said cover plate further comprises a slot formed on said first wall for the removal of said cover plate from said back plate.

43. The button interface as set forth in claim 40, wherein said back plate further comprises a padding member placed on said fourth wall of said back plate for providing a spring fit between said back plate and said cover plate.

44. The button interface as set forth in claim 40, wherein said button interface comprises a security keypad for controlling a security sub-system.

45. The button interface as set forth in claim 40, wherein said button interface comprises a lighting control keypad for controlling a lighting sub-system.

46. The button interface as set forth in claim 40, wherein said button interface comprises an environmental control keypad for controlling an HVAC sub-system.

47. The button interface as set forth in claim 40, wherein said standard electrical box comprises a standard single gang electrical box.

48. The button interface as set forth in claim 40, wherein said standard electrical box comprises a standard double gang electrical box.

49. The button interface as set forth in claim 40, wherein said angle slightly more than 90° is 97° and said angle slightly less than 90° is 83°.

50. An automation system having a plurality of sub-systems, such as a security sub-system, a lighting sub-system, and an environmental control sub-system, comprising:

a controller for providing centralized control of said plurality of sub-systems in said automation system;

a first status indicating means connected to a first sub-system in said automation system and connected to said network for enabling a user to ascertain the status of a first set objects in said first sub-system;

a second status indicating means connected to a second sub-system in said automation system and connected to said network for enabling said user to ascertain the status of a second set of objects in said second sub-system;

wherein said first status indicating means and said second status indicating means represent similar states of said first set of objects and said second set of objects with the same set of indicating signals.

51. The automation system as set forth in claim 50, wherein said first status indicating means and said second status indicating means comprise an LED associated with each object in said automation system.

52. The automation system as set forth in claim 51, wherein an indicating signal in said set of indicating signals comprises a solid on or solid off LED for respectively indicating that its associated object is turned on or off.

53. The automation system as set forth in claim 51, wherein an indicating signal in said set of indicating signals comprises an LED flashing in a pattern for indicating that its associated object is a slave object being assigned to a master object.

54. The automation system as set forth in claim 51, wherein an indicating signal in said set of indicating signals comprises an LED flashing in a pattern for indicating that its associated object is a master object being tuned to accept slave objects.

55. The automation system as set forth in claim 51, wherein an indicating signal in said set of indicating signals comprises an LED flashing in a pattern for indicating that a diagnostic program has found a problem with its associated object.

56. The automation system as set forth in claim 51, wherein an indicating signal in said set of indicating signals comprises an LED flashing in a pattern for indicating that its associated object will be turned off after a time out period.

57. The automation system as set forth in claim 51, wherein an indicating signal in said set of indicating signals comprises an LED flashing in a pattern for indicating that its associated object will be turned on after a time out period.

58. The automation system as set forth in claim 51, wherein an indicating signal in said set of indicating signals comprises an LED pulsing in a sequence for indicating a value of a parameter associated with its associated object.

59. The automation system as set forth in claim 51, wherein a single LED in each keypad will be dimly lit in order to reveal the location of said keypad.

60. The automation system as set forth in claim 50, wherein said first set of objects and said second set of objects comprise devices, scenes, scene sets, and security modes.

61. The automation system as set forth in claim 60, wherein:

said first and second status indicating means respectively comprise first and second button keypads with each keypad having a plurality of buttons; and

a device, scene, scene set, or security mode is labelled on each button with devices being labelled in a first manner, scenes in a second manner, scene sets in a third manner, and security modes in a fourth manner;

whereby a user can ascertain whether a particular button is assigned to a device, a scene, a scene set, or a security mode by the labelling of said particular button.

FIG. 1
PRIOR ART

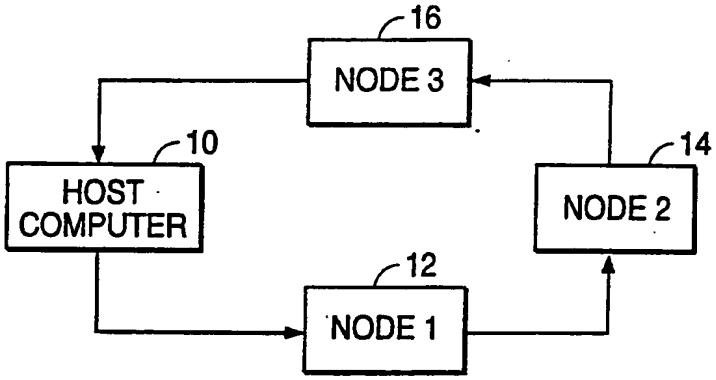


FIG. 2
PRIOR ART

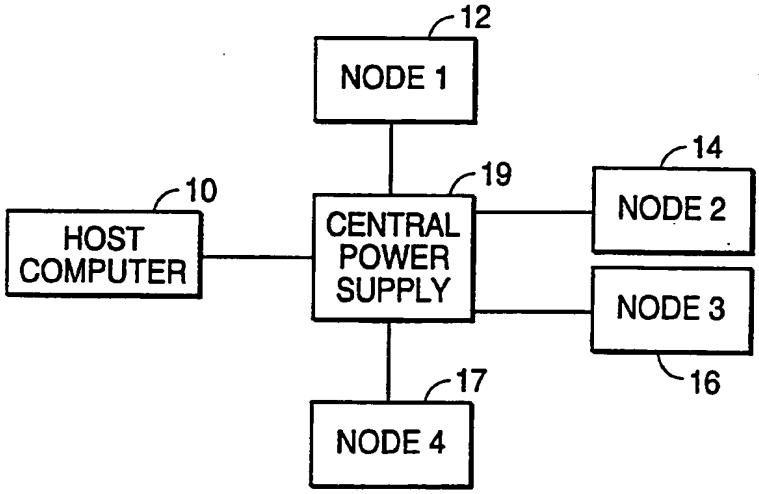


FIG. 3

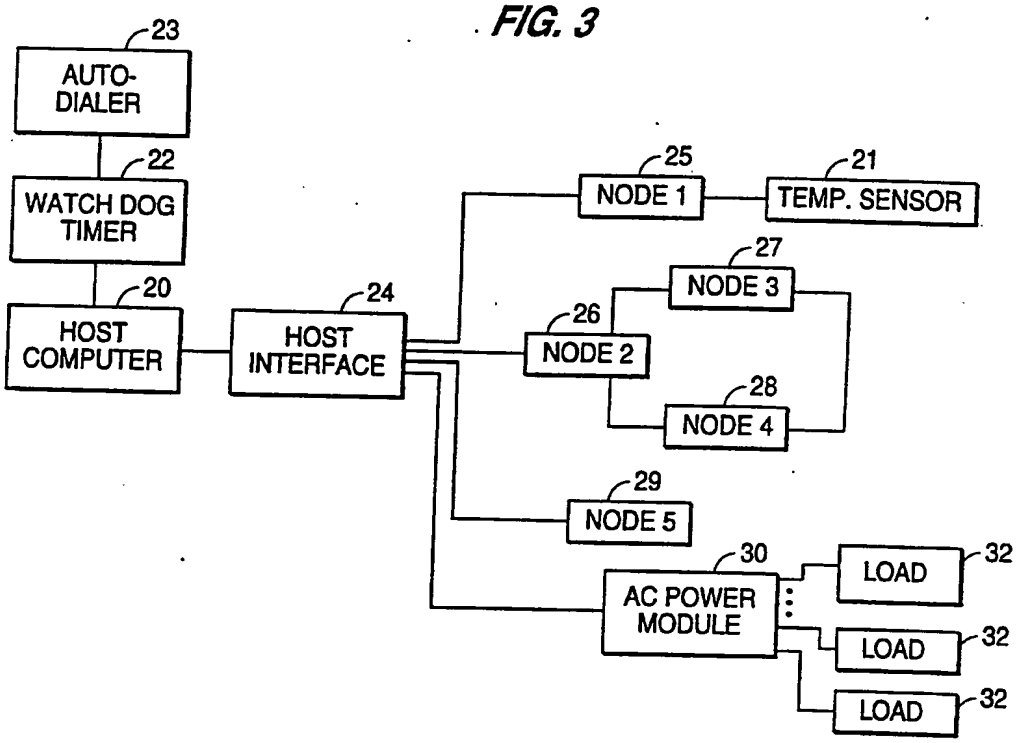

23
AUTO-DIALER
22
WATCH DOG TIMER
20
HOST COMPUTER
24
HOST INTERFACE
25
NODE 1
21
TEMP. SENSOR
27
NODE 3
26
NODE 2
28
NODE 4
29
NODE 5
30
AC POWER MODULE
32
LOAD
32
LOAD
32
LOAD

FIG. 4

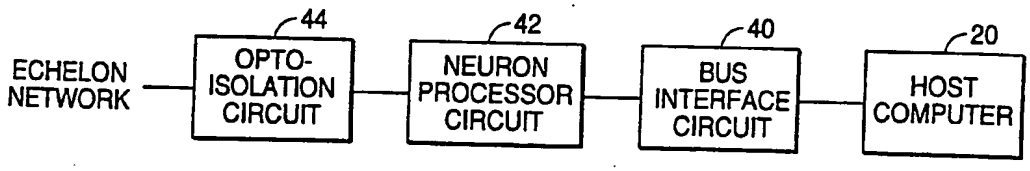
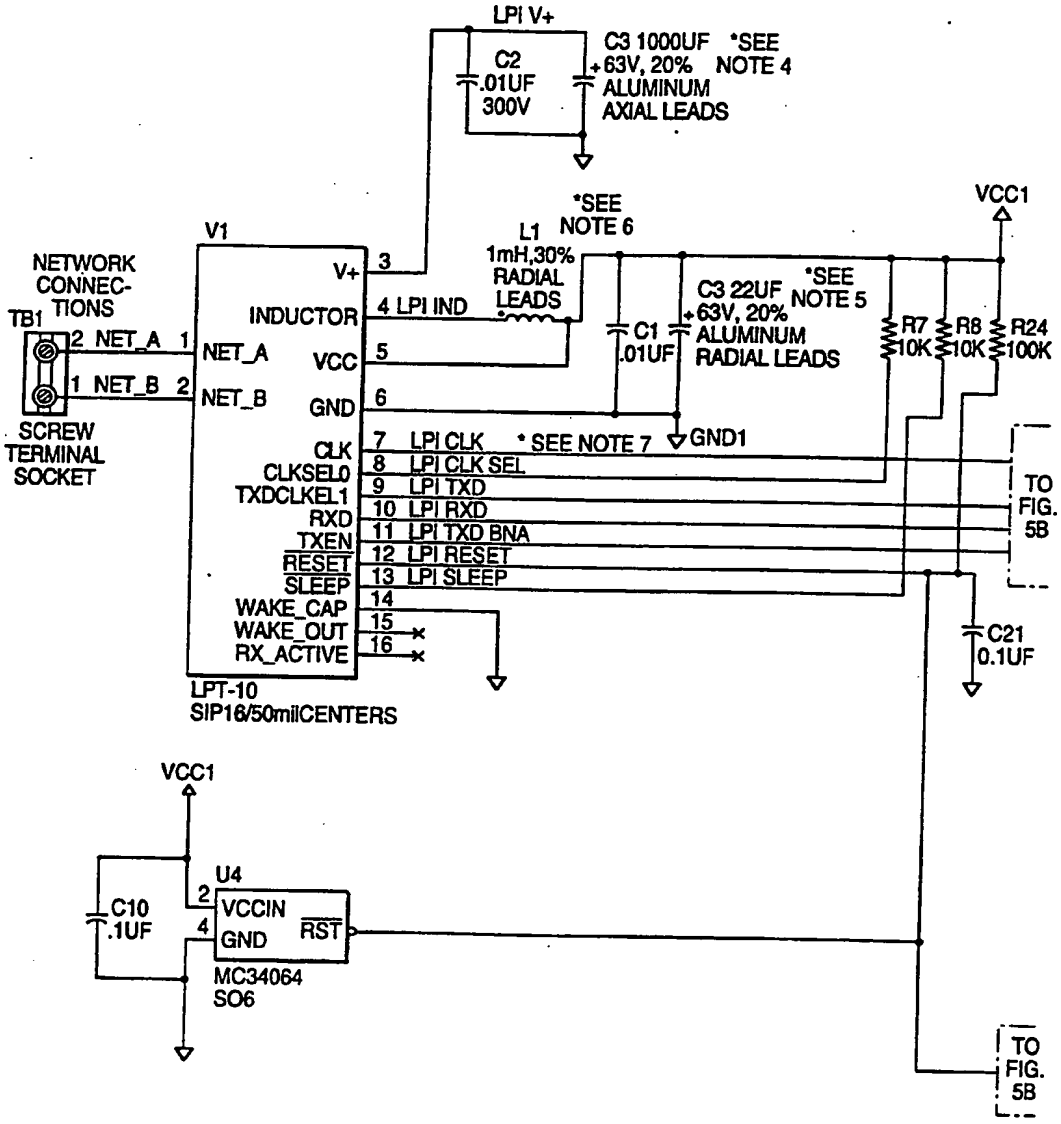

ECHELON NETWORK
44
OPTO-ISOLATION CIRCUIT
42
NEURON PROCESSOR CIRCUIT
40
BUS INTERFACE CIRCUIT
20
HOST COMPUTER

FIG. 5A


LPI V+
C2
.01UF
300V
C3 1000UF *SEE
63V, 20% NOTE 4
ALUMINUM
AXIAL LEADS
VCC1
*SEE
NOTE 6
V1
L1
1mH,30%
RADIAL
LEADS
NETWORK
CONNEC-
TIONS
TB1
V+ 3
INDUCTOR 4 LPI IND
2 NET_A 1
NET_A
VCC 5
1 NET_B 2
NET_B
GND 6
C1
.01UF
C3 22UF *SEE
63V, 20% NOTE 5
ALUMINUM
RADIAL LEADS
R7
10K
R8
10K
R24
100K
SCREW
TERMINAL
SOCKET
CLK 7 LPI CLK * SEE NOTE 7
GND1
CLKSEL0 8 LPI CLK SEL
TXDCLKEL1 9 LPI TXD
RXD 10 LPI RXD
TXEN 11 LPI TXD BNA
RESET 12 LPI RESET
SLEEP 13 LPI SLEEP
WAKE_CAP 14
WAKE_OUT 15
RX_ACTIVE 16
TO
FIG.
5B
C21
0.1UF
LPT-10
SIP16/50milCENTERS
VCC1
U4
C10
.1UF
2
VCCIN
4
GND
RST
MC34064
SO6
TO
FIG.
5B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/01805

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) : G05B 15/00
US CL :Please See Extra Sheet.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 364/138, 146, 185, 505, 514R, 514C, 550; 340/310.01, 310.02, 825.08, 825.06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, DIALOG, STN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 5,086,385 (LAUNEY et al) 04 February 1992, Figs. 1, 2, 10, 12, col. 1, line 66 - col. 2, line 61, col. 4, lines 1-64, Tables 1-6.	7-37,39,50-61.
X	POPULAR SCIENCE, June 1990, Gilmore, Elaine, "The Itegrated Automated Educated House," pp. 104-107, especially pp. 106-107.	7-10.
A	IEEE Tansaction on Consumer Electronics, Vol. 36, No. 4, November 1990, Lin, Tzung-Pao, "A Multi-Function ISDN Home Communication System," pp. 892-896.	7-37, 39, 50-61

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
10 JULY 1995	26 JUL 1995
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer EMMANUEL T. VOELTZ Telephone No. (703) 305-9714

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/01805

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group I, claims 1-6, drawn to an apparatus for interfacing a host computer to link power network, classified in class 395, subclass 200.
Group II, claims 7-37, 39, and 50-61, drawn to an automation system, classified in class 364, subclass 551.01.
Group III, claim 38, drawn to a temperature sensor circuit, classified in class 374, subclass 132.
Group IV, claims 40-49, drawn to a button interface, classified in class 174, subclass 50+.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
7-37, 39, 50-61

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/01805

A. CLASSIFICATION OF SUBJECT MATTER:
US CL :

364/138, 146, 185, 505, 514R, 514C, 550; 340/310.01, 310.02, 825.08, 825.06